REMARKS

Claims 1-17, all the claims pending in the application, are rejected. Claim 1 is amended. Claim 7 is cancelled. New claims 18-24 are added.

The amendment to claim 1 is based on the content of original claim 7.

New independent claims 18 and 19 are based on the description of page 3, line 20 to page 4, line 9 of the original specification.

New independent claim 23 is clearly supported by the description of page 8, lines 20-24 of the original specification.

Claim Rejections - 35 USC § 103

Claims 1-2, 4-9, and 11-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hata (US 2002/0000424) in view of Kitano et al. (US 6,676,757). This rejection is traversed for at least the following reasons.

First, as to claim 7, the rejection is moot in view of the cancellation of the claim.

Amended Claim 1

Second, Claim 1 has been amended to further state that an unnecessary-film-removal process is conducted and that "a difference between a maximum thickness of the resist film and a minimum thickness of the resist film at a region where a transfer pattern is formed is 50 angstroms or less after the unnecessary-film-removal process."

This limitation is added substantially from claim 7. In rejecting claim 7, this key limitation is summarily dismissed as obvious because "the difference between a maximum thickness and minimum thickness of the resist film in the process of Hata in view of Kitano et al. would necessarily be 50 angstroms or less after removing the peripheral resist film because the claimed process and that of Hata in view of Kitano et al. have similar materials and process steps."

Applicants respectfully submit that this limitation is significant, particularly in the context of the invention as a whole when considering the environment and background challenges of the invention, and would not be obvious to one skilled in the art.

Conventional Techniques Faced Problems With Uniformity of Film

As described in "Background Art" in the original specification, in the case of a substrate for a mask blank, excellent uniformity in thickness of the resist film can be achieved by including only the spin-drying process in the spin-coating process. The spin-drying process is a process for preliminarily drying the resist film under a predetermined condition. In the case of a large-sized substrate, only the reduced-pressure-drying process is carried out as preliminary-drying in order to suppress the flow of the resist. Thus, conventionally, it is sufficient to perform either one of the spin-drying process and the reduced-pressure-drying process.

Under the above-mentioned background, the present inventor first found the following problems in the method for removing an unnecessary film disclosed in Hata. That is, in the case where the method disclosed in Hata is used, temperature distribution occurs such that the central part of the cover member has a relatively high temperature and the temperature is gradually lowered towards the periphery of the cover member. When the unnecessary film is removed while the substrate is rotated, the resist is caused to flow under the influence of the temperature distribution or the centrifugal force to cause local variation in film thickness. This results in degradation of uniformity of the in-plane film thickness (see page 3, line 20 to page 4, line 9 of the original specification).

Specifically, in the case where the unnecessary-film-removing process of Hata is applied, even if the resist film after the spin-coating has an in-plane-film thickness uniformity of 50 Å or less, the uniformity of the film thickness is deteriorated in the unnecessary-film-removing process and the ***in-plane-film thickness uniformity exceeds 100 Å***. This is a real and practical problem that not solved by simply examining conventional techniques. Moreover, as the miniaturization of transfer patterns progresses, requirement for in-plane-film thickness

uniformity of the resist films in mask blanks has been increased. Under this circumstance, the resulting practical problem faced by the industry, as representative in Hata, is that it is difficult to adjust the in-plane-film thickness uniformity of the resist films to be 50 Å or less in the unnecessary-film-removing process of Hata (see page 3, lines 10-19 of the instant specification).

Present Invention Solves the Problem Using Two Stages

The present invention has the following features:

(A) a resist film by the spin-coating process includes the spin-drying process (preliminary-drying);

(B) the reduced-pressure-drying process is performed so that a deterioration in an in-plane film thickness uniformity of the resist film caused by the unnecessary-film-removing process is suppressed;

(C) the unnecessary part of the film is removed;

(D) a difference between a maximum thickness of the resist film and a minimum thickness of the resist film at a region where a transfer pattern is formed is 50 angstroms or less after the unnecessary-film-removing process.

By the above-mentioned ***two-stage drying process***, even if the unnecessary film is removed by using the cover member, it is possible to suppress the flow of the resist under the influence of the temperature distribution or the centrifugal force and to improve the uniformity of the in-plane film thickness of the resist film. This is a specific effect that can be achieved by the above-features (A)-(D) of the present invention.

Hata

In the method disclosed in Hata, the unnecessary part of the film is dissolved and removed by the solvent supplied through the solvent supply hole while the substrate and the cover member are rotated together. As admitted by the Examiner in the Response to Arguments,

Hata does not disclose the reduced-pressure-drying process of the present invention. However, the Examiner asserts that Kitano et al. discloses the reduced-pressure-drying process.

Kitano

In the present invention, based on the finding that, upon carrying out the method of removing the unnecessary film by using the cover member, there arises a problem that the resist flows under the influence of the temperature distribution or the centrifugal force and resultant local variation in film thickness degrades the uniformity of in-plane film thickness, the reduced-pressure-drying process is performed.

No Teaching of Reduced Pressure Drying

Kitano et al. does not teach that the reduced-pressure-drying process is performed in order to solve the above-problem ,i.e., by using the cover member, there arises a problem that the resist flows under the influence of the temperature distribution or the centrifugal force and resultant local variation in film thickness degrades the uniformity of in-plane film thickness.

Thus, Kitano et al. fails to disclose the above-feature (B) "the reduced-pressure-drying process is performed so that a deterioration in an in-plane film thickness uniformity of the resist film caused by the unnecessary-film-removing process is suppressed and (D) "a difference between a maximum thickness of the resist film and a minimum thickness of the resist film at a region where a transfer pattern is formed is 50 angstroms or less after the unnecessary-film-removing process".

No Teaching or Motivation for Reduced Pressure Drying

The Examiner notes that Kitano et al. teaches in col. 25, lines 61-67 a combination a spin coating method and a vacuum-drying process. Applicant respectfully traverses.

In order to overcome the problem caused by the spin coating method, Kitano et al. (US 6,676,757) describes, as a method ***independent of*** the spin coating method (col. 1, line 49 to col. 2, line 2), a method combining a single-stroke technique and a reduced-pressure drying process

(col. 2, line 43 to col. 3, line 18). Since Kitano et al. recognizes that non-uniformity in film thickness is caused by the spin coating method (col. 1, lines 55-58), Kitano et al. does not have a technical concept of performing a reduced-pressure drying process for a non-uniform film formed by the spin coating method.

Focus on Single-stroke Technique and Reduced-pressure Drying Process

Furthermore, Kitano et al. describes the structure of a film forming apparatus capable of maintaining the concentration of a solvent in a container constant when a coating film is formed on a substrate (col. 4, line 42 to col. 5, line 4). Specifically, Kitano et al. describes, in the sixth embodiment, the structure of the film forming apparatus in case where the resist is applied by the ***single-stroke technique***. The description "the resist coating unit according to the present invention is also applicable to the case where the application is performed in other methods, for example, a spin coating method" (col. 25, lines 61-67) that is relied upon by the Examiner merely describes that, in connection with a film forming apparatus capable of maintaining the concentration of the solvent in the container constant, the invention is applicable to the spin coating method also.

Thus, Kitano et al. merely describes (1) a method combining the ***single-stroke technique*** and the reduced-pressure drying process, (2) a method combining the ***single-stroke technique*** using the film forming apparatus and the reduced-pressure drying process, and (3) a spin coating method using the film forming apparatus.

As described above, Kitano et al. is based on a technical idea of combining the ***single-stroke technique***, instead of the spin coating method, and the reduced-pressure drying process. Therefore, one skilled in the art would find no teaching or suggestion for combining Kitano et al. with Hata (US 2002/0000424) using the spin coating method.

No Art Teaches Relevant Characteristics of a Flow of Resist

Even if Hata and Kitano et al. are combined, neither Hata nor Kitano et al. has a knowledge of the flow of the resist caused by using a covering member in the unnecessary-film-

removing process. Therefore, even a combination of these references, when considered by one skilled in the art, would not teach or suggest the present invention according to which the reduced-pressure drying process is performed so as to prevent deterioration of in-plane film thickness uniformity of a resist film in the unnecessary-film-removing process and a difference in thickness is suppressed to 50 Å or less even if the unnecessary-film-removing process using the cover member is performed.

For at least the foregoing reasons, the present invention as defined in amended claim 1 is clearly patentable over the cited references.

Claims 2, 4-6, 8, 9, and 11-17

These claims would be patentable at least because of their dependence from amended claim 1.

Claims 3 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hata in view of Kitano et al. as applied to claims 1 and 6 above, and further in view of Okada (US4,748,053). This rejection is traversed for at least the following reasons.

In framing the rejection, the Examiner admits that Hata in view of Kitano et al. "lack a teaching of first applying the resist liquid at a first speed, and then spinning at a second, lower speed in the spin coating process." The Examiner looks to Okada for a teaching that "a uniform film is achieved on the square substrate when spreading of the resist occurs by rotating at a first speed, followed by drying during the spreading step by rotating the substrate at a second speed slower than the first speed (abstract and col. 2, lines 11-26)."

Okada

Okada is cited solely for performing spin coating/drying process at two separate speeds, a first higher speed followed by a second lower speed, and does not remedy the deficiencies of Hata in view of Kitano et al., as noted previously. Accordingly, claim 1 as amended would be

patentable over the combination of three references and claims 3 and 10 would be patentable at least for the same reasons because of their dependency from amended claim 1.

New Claims

Each of the new claims 18 and 19 has the feature "the reduced-pressure-drying process is performed to suppress a flow of the resist film from a central part of the substrate toward the periphery of the substrate by at least a temperature distribution that occurs in the unnecessary-film-removing process".

The cited references fail to disclose these features of the present invention. Accordingly, the present invention is clearly patentable over the cited references.

As discussed above, the present invention is clearly patentable over the cited references.

According to the present invention recited in new claim 20, an unnecessary part of the resist film is removed at periphery of the substrate, and

a difference between a maximum thickness of the resist film and a minimum thickness of the resist film at a region where the transfer pattern is formed is 50 angstroms or less.

The cited references fail to disclose these features of the present invention. Accordingly, the present invention is clearly patentable over the cited references.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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